 **UNIVERSITY OF MAINE AT FARMINGTON**

**COLLEGE OF EDUCATION, HEALTH AND REHABILITATION**

**LESSON PLAN FORMAT**

**Teacher’s Name:** Kiera Timme **Lesson #:** 1 **Facet:** Self Knowledge  
  
**Grade Level: Grade 8 Numbers of Days:** 3   
**Topic:** Properties of Exponents  
  
**PART I:**  
  
**Objectives**  
Students will understand that exponents can be used to express numerical values in different, but equivalent, ways.  
Students will know positive and negative exponents, integers, properties of exponents.  
Students will be able to recognize when, and how, to use the properties of exponents.  
  
**Product:**  
iMovie  
  
**Common Core State Standards (CCSS) Alignment**  
**Content Area:** Mathematics  
**Grade Level:** Grade 8  
**Domain:** *Expressions and Equations*  
**Cluster:** *Work with radicals and integer exponents.*  
**Standard:** *Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 3^2 x 3^-5 = 3^-3 = 1/3^3 = 1/27*  
  
**Rationale:**   
In this class, student will be introduced to the properties of exponents and will explore the steps involved in performing operations with numbers expressed using exponents.  
  
**Assessments**  
**Pre-Assessment:**   
(Lesson 1 only) A prerequisite review, teacher review of student records(prior to start of unit), and student survey/self-assessment  
  
**Formative (Assessment for Learning):**  
**Section I – checking for understanding during instruction**  
Students will use their math journals to summarize their understanding of each of the four exponent properties. Their journals will be used as a form of self-assessment, they will compare their summaries with their peers, and then reflect on what they have written and make any necessary revisions  
  
**Section II – timely feedback for products (self, peer, teacher)**  
Journals will be collected by me and written feedback will be provided**.** They will use their summaries and a checklist to help create their iMovies. I will review their iMovies electronically and then use the same checklist to provide feedback so they can make adjustments  
  
**Summative (Assessment of Learning):**   
Students will create a news report, using iMovie, as if the "Properties of Exponents" have just been discovered and you have to explain them to the world. Get creative! Think about who your audience is, are they nature enthusiasts, scientists, sports fans, etc...? and incorporate this into your news broadcast.  
  
**Integration**  
**Technology:**   
Students will use iMovie in order to create their news broadcast. This will also provide students with an opportunity to utilize other technology including: PowerPoint, Word, Audio recording equipment, and laptops.  
  
**Content Areas:**   
English - Students will be writing in reflective journals (on-going)  
Art (*New Media*) - Students will be using iMovie to create their product  
  
**Groupings**   
**Section I - Graphic Organizer & Cooperative Learning used during instruction**  
Students will be separated into 4 groups using the Numbered Heads activity. Each group will create a flowchart to demonstrate the steps for solving problems using one of the four the properties of exponents. Each group will share their property's flowchart with the other 3 groups.  
  
**Section II – Groups and Roles for Product**  
I will jigsaw my groups right out of my cooperative learning strategy. The groups must contain at least one "expert" from the original exponent property groupings. As students will be presenting a news broadcast, students must decide who will be the: 1. Reporter (s), 2. Camera-person, 3. Creative Director, 4. Researcher. All students must take on the role of "fact-checker" to ensure the content is accurate.  
  
**Differentiated Instruction**  
**Verbal:** Students will writing a journal summary about the properties of exponents. They will also create an iMovie in which they must verbalize the properties of exponents.  
**Logic:** Students will develop their logical thinking skills as they create their properties of exponent flowchart.  
**Visual:** The hook involves visual example of exponent properties in actions. Students will create a flowchart to visualize the steps to solve using the properties of exponents. The iMovie will also include visuals about the properties of exponents.  
**Kinesthetic:** Student will be given post-it notes to write their steps on, and then use these to put the steps in sequence and then transpose this to their flowcharts.  
**Musical:** The "Hook" is a song all about the properties of exponents. During the iMovie "Properties of Exponents News Broadcast" students will be given autonomy over how their news station presents the information, this could include a musical rendition like the hook.  
**Interpersonal:** Students will work in groups to create their flowcharts and iMovie. They will also use peer feedback on both activities to reflect on the learning.  
**Intrapersonal:** Students will work independently when they initially write their exponent properties summary. They will also self-evaluate their iMovies.  
**Naturalistic:** I will create a student sample for the iMovie using a naturalist perspective.

**Modifications/Accommodations**  
***From IEP’s ( Individual Education Plan), 504’s, ELLIDEP (English Language Learning Instructional Delivery Education Plan)*** *I will review student’s IEP, 504 or ELLIDEP and make appropriate modifications and accommodations.*  
  
**Plan for accommodating absent students:**  
The class will have its own Wiki website. All handouts and assignments will be posted on the class wiki. At the end of the class period any SmartBoard presentations will also be uploaded onto the wiki. All students will also be provided with links to Khan Academy that relate to the content being taught to supplement instruction. Anytime a new technology in introduced a student/teacher created screencast or manufacturer tutorial will be posted into the class wiki as a guide on how to use this technology.  
  
**Extensions**  
**Type II technology:**   
Students will use iMovie in order to create their news broadcast. This will also provide students with an opportunity to utilize other technology including: PowerPoint, Word, Audio recording equipment, and laptops.  
  
**Gifted Students:**  
As part of their homework assignment(s), and when student create their products, they will be given a menu of problem choices. From this menu, every student/group will choose two entrees and a choice of two problems from the starters and desserts. These problems will be tiered. Entrees will be designed to meet the standard, Starters will be for designed for students who are working towards the standard, and Dessert will be designed to exceed the standard as a form of extension.  
  
**Materials, Resources and Technology**  
*List all the items you need for the lesson.*

* My laptop
* Student Laptop
* SmartBoard (sign up for this)
* 8 copies of the flowchart per student
* Post-it Notes
* iMovie instruction sheet/screencast
* Audio recording equipment (if in-built microphones not sufficient)
* Digital video recording equipment (if in-build video recorders are insufficient)
* Projector
* Whiteboard
* Whiteboard Markers
* Updated class wiki
* Checklist
* Student self-evaluation/survey
* Textbook
* Problems Menu (posted to class wiki)
* Prerequisite review

**Source for Lesson Plan and Research :**

**Lesson Hook**  
Exponent Song: "Super Base" parody - <http://www.youtube.com/watch?v=QIZTruxt2rQ>  
**Khan Academy Exponent Rules Tutorials**  
Part 1. <http://www.youtube.com/watch?v=kITJ6qH7jS0>  
Part 2. <http://www.youtube.com/watch?v=rEtuPhl6930>  
**iMovie Tutorial:**  
<http://www.apple.com/findouthow/movies/>  
**Class wiki:**  
www.wikispaces.com  
**Screencast:**  
<http://www.screencast.com/>  
**Google Form:**  
linked to class wiki (www.wikispaces.com)  
  
**PART II:**  
  
**Teaching and Learning Sequence (Describe the teaching and learning process using all of the information from part I of the lesson plan)** *Take all the components and synthesize into a script of what you are doing as the teacher and what the learners are doing throughout the lesson. Need to use all the WHERETO’s. (3-5 pages)*  
  
**Agenda:**  
Day One (80 minutes):

* Getting to Know You (40 minutes):
  + - Attendance & Syllabus Review (10 minutes)
    - Explanation of student journals (5 minutes)
    - Pre-assessment (15 - 25 minutes)
* Hook (5 minutes)
* Begin SmartBoard lecture & Group Discussion about the properties of exponents (addition vs. multiplication). Students will be given flowchart to fill in steps (30 minutes)
* Student Journaling Time (5 -10 minutes)

Assignment: Complete GoogleForm Student Survey linked to class wiki. Students will choose from either an entree and a starter or dessert from the menu of problems relating to Day One's lecture and complete a flowchart showing each step they used to solve the problem  
  
Day Two (80 minutes)

* Attendance & H/W and/or Student directed Q&A (5-10 minutes)
* SmartBoard lecture & group discussion about the properties of exponents (powers, division negative exponents) (35 minutes)
* Graphic Organizer & Numbered Heads (20 minutes)
* Jigsaw Grouping to assign iMovie groups and begin planning - allow students time to explore iMovie and watch tutorial (10 minutes)
* Journaling (5 minutes)

Assignment: Meet in respective student groups to design and create iMovie project  
  
Day Three (80 minutes)

* Attendance & H/W and/or Student directed Q&A (5-10 minutes)
* iMovie presentation with peer reviews. Each student will use a checklist to evaluate their peers products (45 minutes)
* Peer feedback review in groups (10 minutes)
* Class discussion on any areas that are still unclear (10 minutes)
* Journaling (5 minutes)

Assignment: Students write an additional journal entry reflecting on their product in light of their peer and teacher feedback.  
  
*Classroom Arrangement*: Students will be arranged into table groups of four  
  
Students will understand that exponents can be used to express numerical values in different, but equivalent, ways**.** Most real world experiences do not follow a straight path. Understanding the way exponents work represents a building block in our understanding of the world. *Know and apply the properties of integer exponents to generate equivalent numerical expressions.* *For example, 3^2 x 3^-5 = 3^-3 = 1/3^3 = 1/27*. Students will be given a prerequisite review. This will not be a traditional problem solving review. Instead of asking students to solve problems, students will be provided with problems which have been solved correctly and incorrectly and they must decide if the solutions are correct or incorrect and then explain their reasoning. At the start of the lesson I will play the exponent Song: "Super Base" parody (<http://www.youtube.com/watch?v=QIZTruxt2rQ>). The video shows real high school students, and their teachers, performing their parody song about the properties of exponents. Student will be given the opportunity to discuss the video and will be asked what they know about exponents.  
**Where, Why, What, Hook Tailors:** Verbal, Logic, Visual, Musical  
  
Students will know positive and negative exponents, integers, properties of exponents (*see content notes*). We will begin by having a lecture and class discussion. Students will then participate in an activity to help them understand the steps involved in solving exponent problems. Students will split into groups of 4. Each group will be given a set of cards with each step involved in solving a problem. Their task is to work collaboratively to determine the correct sequence. After that, students will be separated into 4 groups using the Numbered Heads activity. Each group will create a Flowchart to demonstrate the steps for solving problems using one of the four the properties of exponents (*See Problems Menu*). Students will then create flash cards detailing each step. Each team will challenge the other three groups to put their card in order. For example problems go to *content notes*. Students will then reflect on the lesson, and summarize their understanding, by writing in their journals.  
**Equip, Explore, Rethink, Tailors:** Verbal, Logic, Visual, Kinesthetic, Interpersonal, Intrapersonal  
  
Students will be able to recognize when, and how, to use the properties of exponents. Using the Jigsaw activity students will be divided into groups to create a news report, using iMovie, about the properties of exponents. Student will be provided with class time to begin planning the creation of their products, this will include time to explore the iMovie technology and watch a tutorial of how to use it. The groups must contain at least one "expert" from the original exponent property groupings. Students will be instructed to create a news cast as if the "Properties of Exponents" have just been discovered and they have to explain them to the world. Students will be encouraged to get creative, and to think about who their audience is going to be. For example: Are they nature enthusiasts, scientists, sports fans, etc...? As students will be presenting a news broadcast, students must decide who will be the: 1. Reporter (s), 2. Camera-person, 3. Creative Director, 4. Researcher. All students must take on the role of "fact-checker" to ensure the content is accurate. Students write in their math journals and summarize their understanding of each of the four exponent properties**.** Their journals will be used as a form of self-assessment, they will compare their summaries with their peers, and then reflect on what they have written and make any necessary revisions. Journals will be collected by me, in order to check for understanding, and timely written feedback will be provided. They will use their summaries, flow charts, and a checklist to help create and assess their iMovies.  
**Explore, Experience, Rethink, Revise, Refine, Tailors:** Verbal, Visual, Interpersonal, Intrapersonal, Musical, Naturalist, Logical, Kinesthetic

Students will use their journal entries, graphic organizers and a checklist to help create and self-assess their products. Students will also have an additional opportunity to make adjustments based on peer feedback. I will review their show me products electronically and then use the same checklist to provide feedback so they can make adjustments before the final grading is completed. In order to indicate that they are ready for the products to be assessed, students will post a link to their product onto the class wiki.   
**Evaluate, Tailors:** Verbal, Visual, Interpersonal, Intrapersonal, Logical

**Content Notes**  
Students will know.....  
*Definitions:*

* Integers
* Exponents
* Positive & Negative Exponents
* Negative Exponents
* Properties of Exponents

**Integers:** Positive and Negative Whole Numbers

An integer is a number with no fractional part. Integers include the positive and the negative counting numbers.

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Here are some words associated with integers:

A **negative number** is less than zero.

      - 100, -25, -12 and -4 are all negative numbers.

A **positive number** is more than zero.

      4, 12, 89 and 568 are all positive numbers.

The **negative sign** goes in front of a negative number.

Negative 4 is the same as – 4.

**Integer Exponents:** Positive and Negative Powers

**Positive Exponents**

In this example, our base is 3, and our exponent is 5. This tells us to multiply the number three, by itself, five times.

An exponent tells us how many times to multiply the base number.

= 3 ∙ 3 ∙ 3 ∙ 3 ∙ 3 = 243

REMEMBER: Exponents only expand what they directly touch!

**Note:** Multiplication is repeated addition, so:

**Exponents** are repeated *multiplication*, so:

**Negative Exponents**

A negative exponent is not what it seems…

It is not possible to expand our base of *2*, negative *3* times as we would with positive exponents. Negative exponents mean we have an extra job to do before we can expand them.

The negative sign tell us that the number (with its exponent) is in the wrong place…**They need to move.**Consider a number with a negative exponent as being unhappy where he is. He who has the negative exponent is in the wrong/opposite location. To fix this, imagine there is a top and bottom (upstairs and downstairs), and once you move the number to its opposite location it will be happy.

**How to handle…simplify powers of zero.**

Anything raised to the power of zero equals one…as long as the “0” power (exponent) touches all parts.

*Example:*

1. = 1

****

**TEACHER NOTE**: *Have students use their calculator to solve problem 4 for themselves.*

**Properties of Exponents**

**Addition & Subtraction Rule:**

**TEACHER NOTE**: *Before explaining the exponent rules, use the expansion method to justify the rules. Be sure to provide students with an opportunity to see the pattern and discover the rules for themselves*.

In order to add or subtract numbers with exponents, you must first find the value of each power, then add the two numbers.

For example, to add 33 + 42, you must expand the exponents to get…

33 + 42 = (3 ∙ 3 ∙ 3) + (4 ∙ 4) = 27 + 16 = 43.

**Product Rule:**

1. When you multiply like bases, you keep the base the same and add the exponents.

For example:

52 ∙ 57 = 5(2+7) = 59

1. To multiply exponential numbers raised to the same exponent, raise their product to that exponent.

For Example:

43 ∙ 53 = (4 ∙ 5)3 = 203

1. If you are multiplying unlike bases you must be extra careful. You cannot simply add the exponents and/or multiply the bases. Instead, you must first find the value of each power, then add the two numbers

For Example:

72 ∙ 23 = (7 ∙ 7)(2 ∙ 2 ∙ 2) = 49 ∙ 8

**Quotient Rule:**

1. To divide exponential numbers raised to the same exponent, raise their quotient to that exponent.

For example:

1. To divide two same-base exponential numbers or terms with different exponents, just subtract the exponents.

For example:

NOTE: If you need to multiply or divide two exponential numbers that don’t have the same base or exponent, you’ll just have to do your work the old-fashioned way: multiply the exponential numbers out, and multiply or divide them accordingly

**Power Rule:**

1. When we encounter a power raised to another power, we multiply the exponents.

For example:

(42)3 = 4(2 \* 3) = 46

1. In some cases we must combine the power rule and negative exponents. In this case, distribute the power to each item inside or use pushdown method if the whole item is a negative

Example 1 (Distribution first):

(32)-2 = 3(2 \* -2) = 3-4 =

Example 2 (“Pushdown first):

(32)-2 = = =

**Handouts**  
*Prerequisite skills review*  
*Flowchart*  
*Checklist*  
  
  
**Maine Common Core Teaching Standards for Initial Teacher Certification and Rationale**  
  
***Standard 1 – Learner Development. The teacher understands how learners grow and develop, recognizing that patterns of learning and development vary individually within and across the cognitive, linguistic, social, emotional, and physical areas, and designs and implements developmentally appropriate and challenging learning experiences.***  
  
***Learning Styles***  
  
***Clipboard:*** This lesson is structured to incorporate sequential learning with clear procedures on how to master the content. Lesson expectations are clearly outlined both during the lesson and on the class wiki.  
  
  
***Microscope****:* This lesson allows for student self-discovery of the content. Students are encouraged to discuss the content with their peers, and to develop a sense of ownership of what they are learning. This is facilitated when students are formulating their own solutions, and then sharing their solutions with their peers.  
  
  
***Puppy:*** Students are arranged into small groups to create a supportive atmosphere. At all times every effort will be made to ensure a positive and encouraging learning environment. In particular, during group discussion and presentation, students will be encouraged (and required) to actively listen to their peers comments.   
  
  
**Beach Ball**: The problems menu provides students with a choice in the problems they solve. Student are also free to choose, in their groupings, their roles in the product creation, and the target demographic. Various manipulative are provided during the lesson including flash cards and post it notes, providing several hands-on experiences. The problem menus also provide opportunities for extension.   
  
  
***Rationale:***This lesson is designed to review prerequisite knowledge, including any misconceptions, while also introducing new material in an engaging and meaningful way for all learning styles.   
  
  
**Standard 6 - Assessment. The teacher understands and uses multiple methods of assessment to engage learners in their on growth, to monitor learner progress, and to guide the teacher's and learner's decision making.**  
  
**Pre-Assessment**: (*Lesson 1 only*) A prerequisite review, teacher review of student records, and student survey/self-assessment  
  
**Formative**: Students will use their math journals to summarize their understanding of each of the four exponent properties. Their journals will be used as a form of self-assessment; they will compare their summaries with their peers, and then reflect on what they have written and make any necessary revisions. Journals will be collected by me and written feedback will be provided. They will use their summaries and a checklist to help create their iMovies. I will review their iMovies electronically and then use the same checklist to provide feedback so they can make adjustments  
  
**Summative**: Students will create a news report, using iMovie, as if the "Properties of Exponents" have just been discovered and you have to explain them to the world. Get creative! Think about who your audience is, are they nature enthusiasts, scientists, sports fans, etc...? and incorporate this into your news broadcast.  
  
**Rationale:** A variety of assessment forms are used throughout this lesson. These assessments provide both the teacher to check for student understanding, and to allow students to assess their own understanding.  
  
**Standard 7 - Planning Instruction. The teacher plans instruction that supports every student in meeting rigorous learning goals by drawing upon knowledge of content areas, curriculum, cross- disciplinary skills, and pedagogy, as well as knowledge of learners and the community context.**  
  
**Content Knowledge**: Students will know and apply the properties of exponents.  
  
**Common Core State Standards (CCSS) Alignment**  
**Content Area**: Mathematics  
**Grade Level**: Grade 8  
**Domain**: Expressions and Equations  
**Cluster:** Work with radicals and integer exponents.  
**Standard:** Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 3^2 x 3^-5 = 3^-3 = 1/3^3 = 1/27  
  
**Facet:** Self Knowledge  
  
**Rationale**: Students will be able to recognize when, and how, to use the properties of exponents  
  
**Standard 8 - Instructional Strategies. The teacher understands and uses a variety of instructional strategies to encourage learners to develop deep understanding of content areas and their connections, and to build skills to apply knowledge in meaningful ways.**  
  
**MI Strategies:**  
**Verbal:** Students will writing a journal summary about the properties of exponents. They will also create an iMovie in which they must verbalize the properties of exponents.  
**Logic:** Students will develop their logical thinking skills as they create their properties of exponent flowchart.  
**Visual:** The hook involves visual example of exponent properties in actions. Students will create a flowchart to visualize the steps to solve using the properties of exponents. The iMovie will also include visuals about the properties of exponents.  
**Kinesthetic:** Student will be given post-it notes to write their steps on, and then use these to put the steps in sequence and then transpose this to their flowcharts.  
**Musical:** The "Hook" is a song all about the properties of exponents. During the iMovie "Properties of Exponents News Broadcast" students will be give autonomy over how their news station presents the information, this could include a musical rendition like the hook.  
**Interpersonal:** Students will work in groups to create their flowcharts and iMovie. They will also use peer feedback on both activities to reflect on the learning.  
**Intrapersonal:** Students will work independently when they initially write their exponent properties summary. They will also self-evaluate their iMovies.  
**Naturalistic:** I will create a student sample for the iMovie using a naturalist perspective.  
  
**Type II Technology**: In groups, students will create an iMovie news broadcast to explain and demonstrate the properties of exponents.  
  
**Rationale**: This lesson is designed to meet the needs of all eight multiple intelligences in a meaningful and engaging way. Journaling, with its reflective components, meet the needs of both verbal and intrapersonal intelligences. The hands-on components provide an opportunity for kinesthetic and visual learners to engage with the content. Group work provides interpersonal learners with the opportunity to engage with their peers. The hook is an informative and fun way to remember the properties of exponents in a way that would appeal to musical students. The logical structure and sequence incorporated throughout the exploration of the content appeals to logical students, and the iMovie activity provide naturalist students with an opportunity to incorporate naturalist elements into their product.  
  
  
**NETS STANDARDS FOR TEACHERS**  
**1. Facilitates and Inspire Student Learning and Creativity. Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.**  
a. Promote, support, and model creative and innovative thinking and inventiveness  
  
b. Engage students in exploring real-world issues and solving authentic problems using digital tools and resources  
  
c. Promote student reflection using collaborative tools to reveal and clarify students’ conceptual understanding and thinking, planning, and creative processes  
  
d. Model collaborative knowledge construction by engaging in learning with students, colleagues, and others in face-to-face and virtual environments  
  
***Rationale***: In this lesson, students are exposed to a creative use of technology (the hook), which simultaneously models ways in which students can share their math knowledge with other students. While students may are not creating an exponent song, they are creating a fun and engaging movie that demonstrates their learning. These technology based products are then uploaded to the class wiki and are shared with the school community.  
  
**2. Design and Develop Digital Age Learning Experiences and Assessments. Teachers design, develop, and evaluate authentic learning experiences and assessment incorporating contemporary tools and resources to maximize content learning in context and to develop knowledge, skills, and attitudes identified in the NETS-S.**  
a. Design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity  
  
b. Develop technology-enriched learning environments that enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress  
  
  
c. Customize and personalize learning activities to address students’ diverse learning styles, working strategies, and abilities using digital tools and resources  
  
d. Provide students with multiple and varied formative and summative assessments aligned with content and technology standards and use resulting data to inform learning and teaching  
  
***Rationale:*** Through the use of iMovie, students are provided with the opportunity to explore and utilize a type II technology as a means to demonstrate their learning in a valid and creative way.